REMARKS

In view of the above amendments and following remarks, reconsideration and further examination are requested.

The specification has been reviewed and revised to generally make editorial changes thereto and improve the form thereof, and a substitute specification is provided. No new matter has been added by the substitute specification. Also, enclosed is a "marked-up" copy of the original specification to show changes that have been incorporated into the substitute specification. The attached pages are captioned ***"Version With Markings To Show Changes Made."***

Proposed drawing amendments in red are provided herewith for Figures 1a, 1b, 2, 3a, 3b, 4 and 5. Upon acceptance of these proposed drawing amendments and allowance of the application, formal drawings will be provided.

On pages 1-3 of the Office Action, the Examiner objected to claims 1, 2 and 13 for containing informalities, and rejected claims 1-5, 12 and 13 under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicant regard as the invention.

By the current Amendment, claims 1-13 have been cancelled and claims 14-33 have been added. Claims 14-33 have been drafted taking into account the objection and 35 U.S.C. 112, second paragraph, rejection issued by the Examiner, are believed to be free of the objections and 35 U.S.C. 112, second paragraph, concerns expressed by the Examiner, and are otherwise believed to be in compliance with 35 U.S.C. 112, second paragraph. However, with regard to item (2) of the 35 U.S.C. 112, second paragraph, rejection, the claims continue to recite a "method for monitoring a contaminated, dirty or inflammable condition", since the amount of dust indicated allows one to determine to what extent a contaminated, dirty or inflammable condition exists within the electrical consumer appliance.

Also, with regard to the new claims, claims 14-23 correspond to the elected species.

The instant invention pertains to a method for monitoring a contaminated, dirty or inflammable condition within an electrical consumer appliance. The method includes using a measurement device to measure a parameter that indicates an amount of dust on a surface located within an electrical consumer appliance, and using an indicator to indicate when the amount of dust on the surface exceeds an acceptable limit. The measurement device can be either an optical measurement device, a thermal measurement device, an ultrasound measurement device, a pressure sensor or a strain sensor. Claim 14 is believed to be generic for each of the disclosed species and representative of the invention.

The Examiner rejected claim 1 under 35 U.S.C. 103(a) as being unpatentable over Bruce. The Examiner rejected claims 2, 4, 5 and 12 under 35 U.S.C. 103(a) as being unpatentable over Bruce in view of Venkatesh et al. The Examiner rejected claim 3 under 35 U.S.C. 103(a) as being unpatentable over Bruce in view of Venkatesh et al. and further in view of Hyun et al. And, the Examiner rejected claim 13 under 35 U.S.C. 103(a) as being unpatentable over Bruce in view of Venkatesh et al. and further in view of JP '305. These rejections are respectfully traversed, and the references relied upon by the Examiner are not applicable with regard to the newly added claims for the following reasons.

Initially, please note that new claims 14-23 generally correspond to former claims 1-5, 12 and 13. Accordingly, the references will be discussed as they pertain to new claims 14-23.

In rejecting claim 1 as being unpatentable over Bruce, the Examiner acknowledges that Bruce does not explicitly disclose measuring dust in an "electrical consumer appliance", and concludes that it would have been obvious to use Bruce's system in an electrical consumer appliance. This position taken by the Examiner is respectfully traversed for the following reasons.

While the Examiner states that Bruce discloses a method for measuring a dust thickness on a surface, Bruce actually discloses a method for measuring the thickness of a "dust defocus layer" that is on the surface of an optical disk. The dust defocus layer is not a dust layer, but rather is a transparent layer that is used to protect the optical disk from scratches and dust particles. Accordingly, contrary to the position taken by the Examiner, Bruce does not disclose a method for measuring the thickness of dust on a planar surface. Accordingly, even if one would have found it

obvious to employ the system of Bruce in an electrical consumer appliance, the invention as recited in claim 14 would not be met. Thus, claim 14 is allowable over Bruce.

None of the other references relied upon by the Examiner teach or suggest indicating or measuring an amount of dust on a surface within an electrical consumer appliance. In this regard, **Venkatesh et al.** pertains to a method and apparatus for measuring the thickness of a "film" having top and bottom surfaces. The film referred to in Venkatesh et al. is not a layer of dust, but is rather a web or sheet of material. Please see column 1, lines 23-25, for example. **Hyun et al.** discloses an apparatus for determining reflectivity of a laser mirror by using a CO_2 laser beam in order to detect any possible crack or defect on the mirror surface. While Hyun et al. makes reference to dust (column 1, lines 18-21), the apparatus of Hyun et al. is to determine reflectivity of a laser mirror that may have become damaged or defective because of this dust, but is not said to indicate or measure an amount of this dust. And, **JP '305** is concerned with detection of cavernous defects, such as foam, in an optical fiber. Accordingly, no combination of Bruce, Venkatesh et al., Hyun et al. and JP '305 would result in the invention as recited in claim 14. Thus, for this reason alone claim 14 is allowable over any possible combination of the references relied upon by the Examiner.

Furthermore, claim 14 is specifically limited to indicating of an amount of dust within "an electrical consumer appliance", whereas the references relied upon are not concerned with electrical consumer appliances. Specifically, Bruce is concerned with production of an optical disk, Venkatesh et al. is concerned with an industrial process, Hyun et al. is concerned with a laser, and JP '305 is concerned with an optical fiber, none of which pertain to the electrical consumer appliance as recited in the claims. The problems addressed by Bruce, Venkatesh et al. Hyun et al. and JP '305 are far different than problems associated with buildup of dust in an electrical consumer appliance. Accordingly, for this additional reason no combination of Bruce, Venkatesh et al., Hyun et al. and JP '305 would result in the invention as recited in claim 14.

Thus, claims 14-33 are allowable.

In view of the above amendments and remarks, it is respectfully submitted that the present application is in condition for allowance and an early Notice of Allowance is earnestly solicited.

If after reviewing this Amendment, the Examiner believes that any issues remain which must be resolved before the application can be passed to issue, the Examiner is invited to contact the Applicant's undersigned representative by telephone to resolve such issues.

Respectfully submitted,

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MONITORING DUST DEPOSITION

BACKGROUND OF THE INVENTION

The present invention relates to monitoring a contaminated, dirty or inflammable condition caused by fallout dust. More specifically, the invention is directed to a new use of dust detection equipment to provide a ~~give~~ warning for ~~of the~~ presence or an amount of dust or fine particles on a surface in an appliance.

A main purpose of an indicator for fallout dust is ~~the~~ prevention of fire and explosions. However, one may envisage several important purposes, e.g. (a) being able to prevent particular odor ~~edour~~ related to dust/particle accumulations, (b) being able to improve ~~the~~ efficiency of ~~e.g.~~ cooling units by preventing large accumulations of dust on cooling ribs, since such accumulations impair~~ing~~ heat exchange capability, (c) general improvement/ increasing efficiency of cleaning/service/maintenance programs, i.e. demonstrating more easily a need for cleaning, or (d) being able to maintain important parameters for electrical/electronic apparatuses within given tolerances.

In general it is previously known to measure dust and particle accumulations; however such measurements are typically made in industrial or research related environments. US Patent No. 4,793,710 discloses ~~e.g.~~ a method for measuring dust layers in coal mines, based upon an optical technique, and US Patent No. 5,412,221 also relates to an optical measuring method for small particle deposition~~s~~ ("fallout") in connection with space research. US Patent No. 5,229,602 discloses an optical method for detecting contamination layers particularly on transparent surfaces (headlight glass, windshield) on vehicles.

SUMMARY OF THE INVENTION

However, the present invention is based on a need for safeguarding life, health and property also in a normal consumer environment, and then based upon solutions that can be mass produced at a low cost, especially in such a manner that measurement and display equipment can be integrated in an appliance that is usual in such a normal consumer environment.

In a consumer market that comprises products of ~~the type~~ TV sets, audio and video appliances, larger domestic appliances like refrigerators, stoves, etc., small domestic appliances like coffe makers etc., personal car appliances, computer products like PC's and additional equipment for such products, electrical installations in dwelling units like fuse boxes/panels, electric radiators, lamps etc., it is clear that a dust monitor may be of large interest. A dust monitor may be used also in connection with ~~the~~

allergy problems from which many people suffer. A good indication of dust accumulation in ~~the~~ a close environment of an allergic subject may provide a good basis for demonstrating the efficiency of possible counter measures, or provide a basis for starting such counter measures.

As regards ordinary cleaning, a dust monitor in accordance with the invention can of course also be an aid quite simply in demonstrating ~~the~~ a need ~~of~~ for ordinary cleaning.

When the word "dust" is used in the present description of the invention, ~~and in the patent claims,~~ one has in mind dust of different types, fine particles, dirt etc. A starting point is that the dust in question is fallout dirt consisting of particles that may hover some time in the air. Additionally, within the concept of dust, it is possible to distinguish between house dust, industrial dust and traffic dust. House dust is a mixture of fabric fibers (various forms of fabrics like cotton), and pollen (different forms of pollen, i.e. grain, grass, flower pollen etc.). Industrial dust is various types of waste products like grinding dust from wood and metals, and other waste products (contamination, pollution). Traffic dust is a mixture of asphalt, exhaust and different types of gases (pollution).

Hence, the purpose of the invention is to provide a warning/indication regarding accumulation of dust in important positions for consumers, and in accordance with the invention this has been achieved through a use of the type defined in the appended ~~patent~~ claims.

BRIEF DESCRIPTION OF THE DRAWINGS

In the following the invention shall be illuminated further by examining certain exemplary embodiments, and in this connection it is referred to the appended drawings, where

Figs. 1a and 1b show schematically a dust meter of an optical type, in views from above and from ~~the~~ a side, respectively,

Fig. 2 shows a circuit diagram for an optical detector used in the dust meter shown in Figs. 1a and 1b,

Figs. 3a and 3b show a dust meter of a thermal type, in views from above and from ~~the~~ a side, respectively,

Fig. 4 shows a circuit diagram for a detector in connection with the thermal dust meter shown in Figs. 3a and 3b, and

Fig. 5 shows a dust meter that can be us d in accordance with th invention, in its most general form.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A concrete use of the invention is, as mentioned above, in conn ction with detecting and giving a warning regarding dust accumulation in a TV set. The embodiments now to be discussed with reference to the drawing are envisaged in such a connection, but it is emphasized once more that also other consumer appliances are of interest, as explained previously. In ~~figs.~~ Figs. 1a and 1b ~~appears~~ appear a schematic layout for a dust meter that is mountable inside a TV set. A plate 2, preferably arranged horizontally will little by little accumulate dust and particles that are deposited from ~~the~~ an air space above the plate. A light source 1 is arranged at the left end of the plate 2, which light source emits light in such a manner that it propagates at least along ~~the~~ a top side of the plate 2, and in addition in a space above the plate that supposedly does not contain any dust, i.e. ~~in~~ at such a height above the plate that it is improbable that a dust layer will ever grow that high. The two main light paths appear in ~~fig.~~ Fig. 1b, i.e. two light paths indicated by ~~means of~~ two divergent pairs of broken lines. (Light may of course also spread outside of these directions, but such light will not be of any use in connection with ~~the~~ an actual measurement.)

A screen 3 provides a division between ~~the~~ two light beams of interest, the two light beams being termed A and B, i.e. A in the dust layer area, and B in the air space above the dust layer.

As appears from ~~fig.~~ Fig. 1a, it is ~~favourable~~ favorable to have a wide light beam, or ~~making~~ make the light beam spread such as shown in ~~the figure 1~~ Figs. 1a and 1b, along the dust layer, in order to increase measurement sensitivity and to decrease uncertainty. A lens 4 collects both beams ~~parts~~ A and B to respective detection areas, where two separate detectors 6, 7 measure light intensities. The lens 4 may be a normal convex lens, or, such as indicated in the figures, a cylinder lens, since it may be sufficient to focus the light in ~~the~~ a horizontal plane. It will be ~~favourable~~ favorable to build both detectors 6,7, the lens 4 and the screen 3 together inside a closed box 5, indicated in the figures by broken lines.

The intensity of light beam A will be reduced when the dust thickness on plate 2 grows, while the reference light in beam B will not be influenced by this layer of dust. Dust on the light source 1 will att nuate both beams equally. It is possible to adjust ~~the~~ a recordable dust thickness mechanically by adapting ~~the~~ a height of ~~the~~ a light slit between screen 3 and plate 2. The top surface of plate 2 should be dull so as to avoid reflections. As mentioned, it is ~~favourable~~ favorable with a light

beam having a certain width in ~~the~~ a horizontal plane, and this can ~~e.g.~~ be achieved by ~~means~~ virtue of a (not shown) lens between the light source 1 and ~~plane~~ plate 2, or by making the light source emit a relatively wide beam such as shown in Fig. 1a.

Regarding ~~the~~ an electric/electronic aspect of this matter, ~~it is~~ referred to is Fig. 2 which shows an easily realized design of ~~the~~ electrical circuitry that is necessary in connection with the configuration of Fig. 1a ~~/~~ and 1b. The light source 1 is shown in a simple circuit at the left in the figure, in the form of a light-emitting diode (LED), and in ~~the~~ a detection circuit to the right in the figure, detectors 6 and 7 are shown as phototransistors connected in a simple manner to provide input signals for a differential amplifier 8 (It is also possible to use photodiodes.) As the dust thickness increases, and thereby beam A is attenuated, ~~the~~ a ratio between ~~the~~ two voltage inputs to the differential amplifier 8 is upset, and ~~the~~ voltage output form the differential amplifier 8 will ~~e.g.~~ increase. This is detected by ~~means~~ virtue of ~~the~~ comparator 9 which compares to a fixed reference voltage delivered by a simple voltage divider. If ~~the~~ output from comparator 9 exceeds a certain voltage, ~~the~~ an alarm light diode 10 is switched on, and this represents a possible indication that an undesired thickness of the dust layer has been reached.

The electronic circuitry after the photo detectors 6,7 will in reality depend on how ~~the~~ possible dust recordal shall be indicated, i.e. if, such as shown here, a light diode shall be lit, if a measurement value shall be exhibited in a display, or possibly in a TV screen, or a special indication may also be cutting ~~the~~ supply voltage ~~of~~ from the TV set.

Hence, in the shown embodiment, ~~the~~ an exceeded dust limit is marked by lighting a light diode, and by outputting a logic "high" signal. However, it is quite feasible to grade the alarm for indicating several thicknesses of dust, but this will then require a somewhat different circuit solution than what has been shown.

If the detector is to be located in an area where light can get in, the light source 1 should be modulated so that ~~the~~ a receiver part can be AC coupled; however, such a solution has not been shown in the drawings ~~either~~. The solution with a modulated light source will of course be a little more costly.

As a matter of principle, it will of course also be possible to transmit light "transversely" to the dust layer; that is in Fig. 1b with a light source situated above plate 2, preferably with a light beam expanding element in the form of a lens, with a transparent or reflecting plate 2, and with detection below or above the plate,

r spectiv ly. A ref rence measurement must then be made in some other manner, e.g. with a detector attached to the light source in a dust-free configuration, i.e built-in together with the light source.

Experiments that have been conducted in accordance with the solution shown in figs. 1a, 1b and fig. 2, show that ~~the~~ light traveling along ~~the~~ a dust surface, will be attenuated approximately in proportion to ~~the~~ dust thickness. ~~The~~ experiments further indicate that ~~the~~ density of the dust layer is of little importance with this detection solution.

Quite different measurement techniques than optical detection can also be used regarding detecting dust layers, and in fig. 3a and 3b is shown a thermal detector for the same purpose. The principle utilized here, is based on the fact that a dust layer will have an insulating effect, so that ~~the~~ temperature ~~in~~ of a heated surface will increase with increasing dust thickness. To achieve a reliable detection, a reference measurement toward a point that does not depend on the dust layer, should be used.

The thermal detector is built on an insulating support D in order to maintain a heat loss that is as small as possible in that direction. Heating elements may be two resistors 11 and 12 connected in parallel and placed on respective cooling surfaces 15 and ~~28~~ 16, as shown in fig. 3a which is a top view of the detector. The cooling surface 15 is ~~the~~ an actual dust sensor, which little by little shall be coated by dust, while cooling surface 16 is a reference. Cooling surface 16 is made insensitive to dust by covering it ~~by~~ with an insulation layer E that is not too thick. Here it is a goal that ~~the~~ thermal resistance through insulation layer E shall be significantly higher than ~~the~~ thermal resistance in a dust layer, so that such a dust layer does not influence ~~the~~ heat emission from the cooling surface. In order to obtain sufficient cooling despite this, ~~that~~ cooling surface 16 is made relatively large.

Thermistors are preferably used as temperature sensors 13 and 14. (Other types of sensors are of course also of interest, e.g. thermocouples.) The dust sensor, i.e. the cooling surface 15, will have a reduced cooling effect when it is gradually covered by a dust layer, so that ~~the~~ temperature in the thermal sensor 13 will be a function of ~~the~~ dust thickness. ~~The~~ Temperature in thermal sensor 14 will on the other hand stay substantially constant, even if dust falls upon the insulation layer E.

Closely adjacent to the thermal sensors 13 and 14, the temperature should be substantially higher than ~~the~~ ambient temperature. This is achieved by supplying sufficient power (about 1-5 watts ~~watt~~), and by insulating above the thermal sensors and the heating elements via ~~an~~ insulation layer C~~9~~. ~~The~~ Physical dimensions of insulating layer C may be about 5 x 5 cm ~~and~~ with a maximum height about 2 cm, as seen in ~~see~~ Fig. 3b.

An example of a circuit diagram in connection with the thermal detector shown schematically in Figs. 3a and 3b, appears in ~~from~~ Fig. 4. In the example shown in Fig. 4, an ~~the~~ end part of a ~~the~~ detection circuit is rather similar to that shown in ~~what appeared from~~ Fig. 2 regarding the optical detection circuit, i.e. from a ~~the~~ differential amplifier 17 through a ~~the~~ comparator 18 and to an alarm light-emitting diode 19. However, the photo-transistors 6 and 7 in Fig. 2 are exchanged ~~changed~~ for thermistors 13 and 14 in Fig. 4, for delivering signal voltages to the differential amplifier 17. Each one of the thermistors 13 and 14 is part of a voltage divider together with resistors R2 and R1, respectively. ~~The~~ Heating elements 11 and 12 are part of a separate, simple parallel circuit.

All resistors in the above-described ~~disclosed~~ circuit, including the heating elements, should have a tolerance of 1% or better, while ~~the~~ accuracy of ~~the~~ supply voltage U is not critical.

Both ~~the~~ described solutions for detecting dust layer thickness are simple, and the total cost in mass production can be expected to be less than NOK 10 in both alternatives, with the thermal solution being the less expensive ~~cheaper~~ one.

One further possibility for detecting a dust layer is a mechanical sensing method, which method can be based upon a strain principle or a pressure principle. The strain principle is based on bending a plate due to ~~the~~ dust weight. In such a case a strain gauge may be an ~~the~~ actual sensor. When the pressure principle is used, a pressure sensor on an ~~the~~ underside of an accumulation surface senses ~~the~~ weight of the dust layer, that is ~~the~~ superpressure growing ~~coming~~ gradually in addition to ~~the~~ start pressure caused by ~~the~~ weight of the surface/plate itself.

Independent of the type of sensor that is used, a signal from the sensor will normally have to be amplified, i.e. an ~~the~~ amplifier succeeding the sensor shall record current or voltage from the sensor, and adapt a ~~the~~ level for a ~~the~~ display unit that may be of various types. In order to make relative measurements, the amplifier should be a differential amplifier with the sensor in a measurement bridge.

Regarding the display unit, this unit may be of several different types. As shown in fig. 2 and fig. 4, display takes place by virtue ~~means~~ of a simple light-emitting diode, which is lit when the dust layer reaches a certain thickness. It is of course also possible with a display of a more advanced type, e.g. for displaying an ~~the~~ actual thickness of the dust layer as measured by ~~means of~~ a suitable unit of measurement. A seven-segment type display or an intelligent display may then be utilized. Further possibilities are that the display unit may control a current switch for switching off an ~~the~~ appliance in question if the dust thickness exceeds a critical value. Further possibilities include connection to a monitor screen with an opportunity for text in the screen. This last mentioned solution may ~~e.g.~~ be of interest if the dust monitor is to ~~shall~~ be built-in in an integrated manner in a TV set or a computer monitor.

In this last mentioned case it is favorable ~~favourable~~ to manufacture a ~~the~~ dust warning unit as an individual unit, or possibly as an integral part of an appliance. If the dust warning unit is produced as an individual unit, it must be suitable for fitting into the appliance at a later time. As an integral part, it will be included as a production element in an appliance, e.g. a TV set, and as previously mentioned, possibly at a very low cost.

~~The~~ Voltage supply may be standardized ~~e.g.~~ at 5.0 volts. This voltage may vary within a given range, without influencing ~~the~~ reliability of the dust monitor.

As previously mentioned, it is favorable ~~favourable~~ to base the dust sensor on relative measurements, so that external and spurious influences shall not be disturbing.

Quite generally it is important to underline that the "warning" that shall take place, may take place in different manners. As mentioned above, one may most easily visualize a light indicator in some form (one further such indicator may be a simple luminous indication with a color ~~colour~~ dependent on dust amount), but it may also be of interest to use an acoustic signal, i.e. some form of sound emission. Also ~~and~~ a text indication as mentioned above in connection with a TV set/computer monitor is an important possibility. Of course, one may also visualize a combination of these indication modes.

It is ~~seems~~ also favorable ~~favourable~~ in certain applications to provide ~~have~~ the possibility that the display may provide information that the system is operational, and that it is working.

In fig. 5 is shown ~~appears~~ a dust measurement devic in its most general form as mentioned above, i.e. independent of a ~~the~~ physical measurement principle that

may be optical, thermal, weight-based, ultrasound-based, possibly based on measurement of electrical characteristics like resistance, capacity etc. Absorption/attenuation of ~~other~~ types of radiation other than optical and ultrasound radiation can be envisaged, e.g nuclear radiation with a radiation source similar to the one that is utilized in smoke detectors. Thus, in this figure "the dust sensor", which normally will require a voltage supply, comprises some sensor type that is able to deliver a signal depending on ~~the~~ a dust amount that is measured. The signal passes to an amplifier that delivers an output signal further to a display unit and possibly to an alarm unit. The display unit may preferably comprise or be attached to a monitor screen, and it may possibly be switchable on~~/off~~ and off by ~~means~~ virtue of a switch.